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ORIGINAL ARTICLE

Intraobserver and interobserver agreement in the classification and treatment of proximal humeral fractures

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Background: There is controversy surrounding the reliability of radiographic measurements and existing classifications for proximal humeral fractures.

Methods: Ten orthopedists, divided into 2 groups by length of experience, evaluated radiographs in 3 views from 40 proximal humeral fractures. We evaluated 11 radiographic criteria (including the Neer and pathomorphologic classifications, head-shaft angle, displacement of the humeral shaft, and lesser and greater tuberosities) and treatment indication. We also analyzed the criteria that most influenced the choice of treatment.

Results: Interobserver reliability was substantial for the presence of fracture of the greater tuberosity ($\kappa = 0.749$) and medial metaphyseal comminution ($\kappa = 0.627$) and moderate for the pathomorphologic classification ($\kappa = 0.504$), displacement of the greater tuberosity ($\kappa = 0.422$), and treatment decision ($\kappa = 0.565$). Intraobserver reliability was substantial for treatment indication ($\kappa = 0.620$) and presence of displacement of the fracture of the greater tuberosity ($\kappa = 0.627$ and 0.611) and moderate for the Neer ($\kappa = 0.490$) and pathomorphologic ($\kappa = 0.607$) classifications. The results were influenced by the observer's experience. The surgical indication was influenced by the pathomorphologic classification in 50% of the evaluators (odds ratio, 4.85; range, 3.30-8.65).

Conclusion: The pathomorphologic classification has higher reliability than the Neer classification and was the factor that most influenced the surgical decision. The determination of the presence of fracture and displacement of the greater tuberosity and medial metaphyseal comminution is reliable with the use of simple radiographs, and the results were influenced by the observer's experience.

Level of evidence: Basic Science Study; Validation of Classification System

Keywords: Proximal humerus fracture; classification; pathomorphology; interobserver reliability; varus; valgus

Fractures related to osteoporosis occur in around 2 million individuals a year in the United States, and proximal humeral fractures (PHFs) represent 10% of these.[4,13,19] Recent studies demonstrate that conservative treatment has similar results to surgery, regardless of age and the pattern of the fracture.[9,22]

This study was approved by the Ethical Committee of the University of São Paulo: No. 940.561.

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However, there is still controversy about the main patterns that benefit from surgical treatment, and there is a lack of evidence on the radiographic parameters that give the worst prognosis for conservative treatment. The Neer, AO, and binary classifications have low reliability and add little to decision-making on treatment.[2,14] Previous studies demonstrated that various characteristics related to the fracture and not evaluated by these classifications can influence the functional results, such as medial metaphyseal comminution,[11] the direction and degree of displacement in the coronal and sagittal planes,[6,8,14] and bone loss due to impaction.[8]

Resch et al[23] recently published a new classification, based on the pathomorphologic analysis of these fractures, using only the criteria with excellent interobserver correlation by radiographic and tomographic analysis. The influence of the pathomorphologic classification and other objective criteria of PHF displacement in the treatment decision was not previously evaluated, and neither was its reliability with the use of simple radiographs, without computed tomography.

Our primary aim was to evaluate the interobserver and intraobserver reliability of different radiographic parameters, classifications, and surgical indication in PHFs among orthopedic surgeons with different levels of experience. The secondary aim was to evaluate which criteria most influence decision-making for treatment. Our hypothesis was that there is significant variability in the radiographic measurements, with best results among the more experienced evaluators.

Materials and methods

Patients and images

Through the analysis of an institutional database of PHFs, the records were obtained for patients with a diagnosis of PHF treated between January 2009 and August 2014. With the registration numbers, the radiographs were accessed, using the picture archiving and communication system (PACS) of the hospital (iSite Enterprise 4.1; Philips Medical Systems, Best, The Netherlands).

Patients who did not have good-quality radiographs in the true anteroposterior, lateral, and axillary views were excluded, as were patients with open physis and those older than 90 years. Other reasons for exclusion were isolated fractures of the tuberosity, pathologic fractures, presence of previous fracture, and fracture-dislocation.

The radiographs were evaluated by the main author, who selected 40 patients according to the sample size calculation. The images were arranged randomly for evaluation, with the patients' identifications blinded. Cases were selected with similar distribution between the number of fragments affected and the severity of the coronal angular displacement of the humeral head.

Observers and survey

The research was performed by 10 orthopedic surgeons. They were divided into 2 groups by length of experience. In the experienced group, all were specialized in shoulder or trauma surgery, with an average of 16 years (±10.1) of experience, and accustomed to treating PHFs. In the nonexperienced group, the orthopedic surgeons were recently trained in orthopedics and traumatology, with an average of 1.4 years (±0.5).

Eleven questions with multiple choices were asked (Table I). The options were chosen on the basis of previous classifications and pathomorphologic findings.[14,17,23] Clear, written instructions were given on how to calculate the angles and displacements. The measurements were performed using PACS tools, and the responses to the questionnaire were filled out by the orthopedists in a printed version. The evaluators were instructed to use the criteria for treatment decision used in their clinical practices. A single clinical situation was considered for all cases: a patient aged 55 years, without

Table I Survey for evaluation of proximal humeral fractures

Parameter
Neer classification
Pathomorphologic classification
Fragments fractured
Greater tuberosity
Lesser tuberosity
Anatomic neck
Surgical neck
Head angulation in coronal plane
<20°
Varus (20°-45°)
Varus (>45°)
Valgus (20°-45°)
Valgus (>45°)
Diaphysis displacement in coronal plane
No displacement
Head-diaphysis contact ≥ 50%
Head-diaphysis contact < 50%
No contact between head and diaphysis
Head angulation in sagittal plane
<20°
20°-45°
>45°
Diaphysis displacement in sagittal plane
No displacement
Head-diaphysis contact ≥ 50%
Head-diaphysis contact < 50%
No contact between head and diaphysis
Medial comminution
No
Yes
Greater tuberosity displacement
<5 mm
5-10 mm
>10 mm
Lesser tuberosity displacement
<5 mm
5-10 mm
>10 mm
Surgical treatment
No
Yes